

CSE474/574

## Programming Assignment 1

# Handwritten Digits Classification

Compiled By:

Team 51

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## PART A

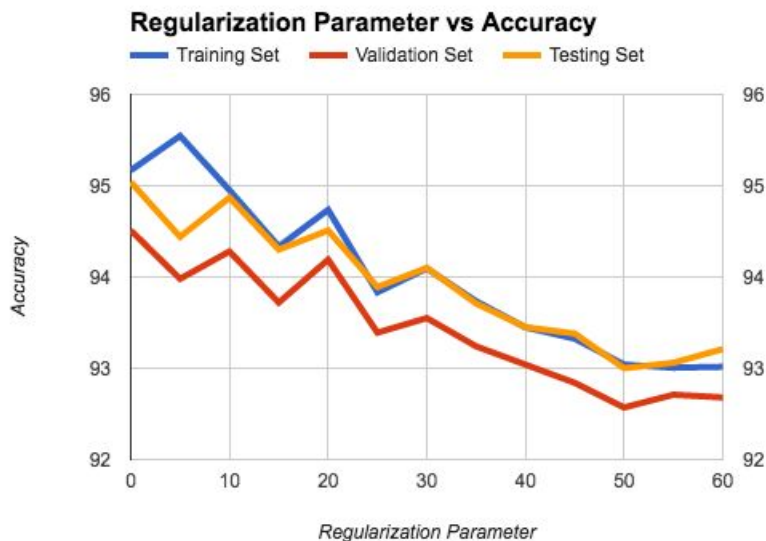
Goal of this assignment was to implement a Multilayer Perceptron Neural Network and evaluate its performance in classifying handwritten digits.

Choosing the right hyper-parameters for Neural Network

1. **Regularization Term** : While keeping the number of hidden nodes constant ( $n_{\text{hidden}}=50$ ), the nnScript.py was run for different values of lambda (regularisation parameter) ranging from 0 to 60.

Below is the observation table and the graph for the same.

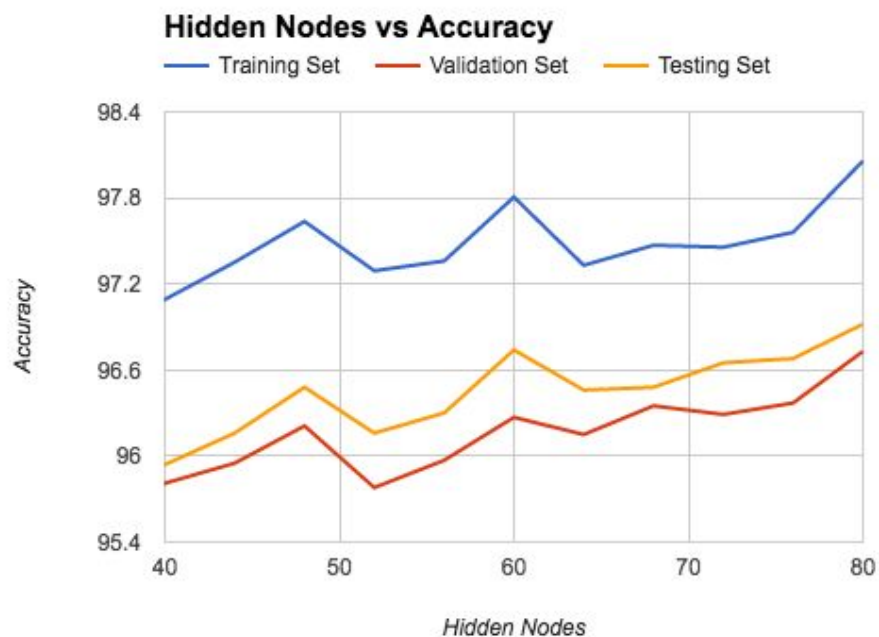
Regularization Parameter	Training Set	Validation Set	Testing Set
0	95.168	94.51	95.04
5	95.546	93.98	94.44
10	94.952	94.28	94.87
15	94.334	93.72	94.3
20	94.736	94.19	94.51
25	93.832	93.39	93.89
30	94.094	93.55	94.1
35	93.734	93.24	93.71
40	93.448	93.04	93.45
45	93.324	92.84	93.38
50	93.04	92.57	93
55	93.006	92.71	93.06
60	93.016	92.68	93.21



**Inference-** As the value of lambda is increased, the accuracy decreases. This is because on increasing the value of lambda, less importance is given to the error function and more importance is given to the weights. Therefore, we chose the value of lambda to be 5 in the range of 0 to 60 which gives us the accuracy of 94.44% for Test Set and 95.546% For Train Set.

**2. Number of Hidden Units :** From the previous experiment the regularization parameter was decided to be 5. Now we proceed forward by keeping the Regularization Parameter constant and varying the number of hidden nodes. Below is the observation table and the graph for the same.

Hidden Nodes	Training Set	Validation Set	Testing Set
36	96.758	95.34	95.73
40	97.092	95.81	95.94
44	97.352	95.95	96.16
48	97.636	96.21	96.48
52	97.292	95.78	96.16
56	97.36	95.97	96.3
60	97.806	96.27	96.74
64	97.33	96.15	96.46
68	97.47	96.35	96.48
72	97.456	96.29	96.65
76	97.56	96.37	96.68
80	98.058	96.73	96.92



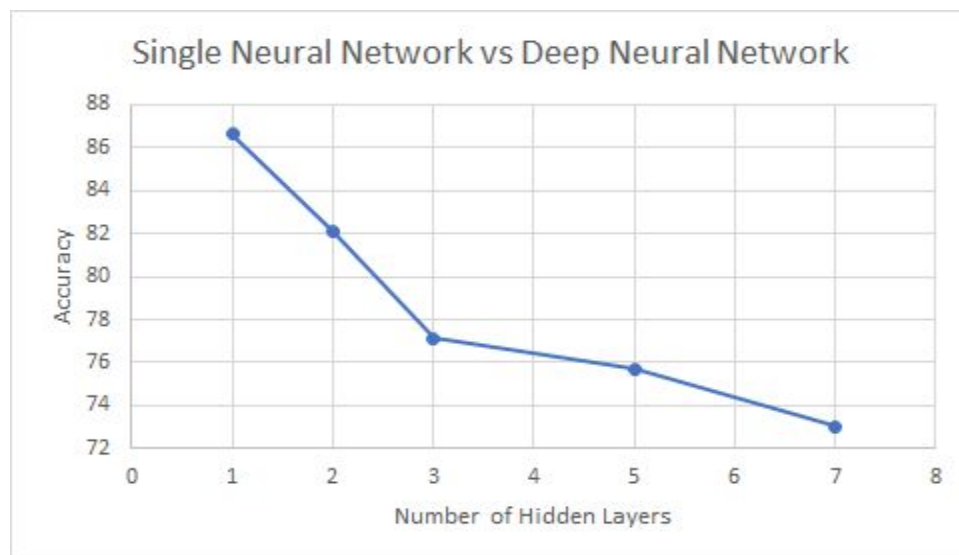
**Inference:** The maximum accuracy of 96.92% for test data with 80 hidden nodes while keeping value of lambda constant at 5 was obtained.

## **PART B**

Goal of this experiment was to compare the results of deep neural network(with multiple hidden layers ) and neural network with one hidden layer on the CelebA data set.

Below is the observation table and the graph for the same.

Hidden Layers	Test Data
1	86.6389
2	82.1347
3	77.1385
5	75.7002
7	73.0129



**Inference** - We see that on increasing the number of hidden layers, the accuracy decreases i.e the accuracy with single neural network is more as compared to Deep Neural Network.